

NORTHWESTERN UNIVERSITY TRANSPORTATION CENTER

BUSINESS ADVISORY COUNCIL FALL MEETING

UNCONVENTIONAL FUELS: IMPACT ON TRANSPORTATION

October 31, 2012 Evanston, IL

Our topic for today



Conventional Fuels

- Wood
- Fossil
 - Coal
 - Gas
 - Oil
- Hydropower
- Nuclear
- Geothermal



Unconventional Fuels

- Shale gas
- Oil sands
- Shale oil
- Renewables



Critical Components

- Proppants
- FRAC chemicals
- Sand
- Ceramics
- Water

Plus Mix Variations

- Methane
- Butane
- Carbon

- Ethane
- Pentane
- Dioxide

Propane

Nitrogen

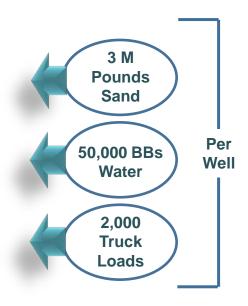
Very transportation Intensive



Rig-Related Movements Per Well

ltem	Nr. Of Trucks	Inbound/ Outbound	
Sand	80	Inbound	
Water (fresh)	400	Inbound	
Water (waste)	200	Outbound	
Frac Tanks	100	Both	
Rig Equipment	50	Both	
Drilling Mud	50	Inbound	
Chemical	4	Inbound	
Cement	15	Inbound	
Pipe	10	Inbound	
Scoria/Gravel	80	Inbound	
Fuel Trucks	7	Inbound	
Frac/Cement Pumper Trucks	15	Inbound	
Workover Rigs	I	Inbound	

S	I		Inbo
Total — One	e Direction	١,	012
Total Trucks		2,	024



Raising a number of issues



- Revenue growth rail, truck, pipeline, barge, ship
 - Substitution coal, ethanol?
 - Location moving west to east, north to south
 - Domestic/foreign export opportunities
 - Infrastructure rural vs. intercity vs. export
 - Equipment supply quality/supply/safety
 - Environmental air/noise/water vs. national/local
 - Safety workforce, communities
 - Mode pipeline vs. rail vs. truck

Our panel today

Charles H. Dowding

- Associate Chair, Civil & Environmental Engineering
- Northwestern University



Graham Brisben

- CEO/Founder
- Professional Logistics Group



Carol Orndorff

- Director Chemicals
- Norfolk Southern Railroad



Doug Allen

- Executive Vice President
- Kenan Advantage

